

4-20-15

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From: Alliance For A Clean Environment, ACE  
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Re: **Changes to Technical Guidance Related to Reactor Embrittlement**

DRAFT Guidance Regarding the Alternative Pressurized Thermal Shock Rule - Docket ID NRC-2014-0137

ACE strenuously objects to NRC's proposed draft regulatory guide DG-1299 and accompanying draft NUREG -2163, that would weaken nuclear reactor embrittlement standards.

NRC's is failing to require stringent independent testing for metal fatigue and microcracking in U.S. reactors continually degraded by the reactive process.

In essence, NRC's proposal would provide yet another dangerous loophole, which is just the latest in a series of NRC changes that weaken NRC's original safety standards.

Recently, news has been pouring in concerning reactor pressure vessel (RPV) flaws at nuclear reactors around the world.

This proposal appears to be another of NRC's tactics to avoid requiring regulatory compliance for embrittlement testing in U.S. reactors. NRC's proposal appears to be in response to the shocking unexpected discovery of 16,000 cracks in two Belgium reactor pressure vessels (RPVs).

Belgium's nuclear regulators urged nuclear agencies across the world to conduct the same tests that were done in Belgium to determine whether nuclear reactor microcracking may be an endemic problem for reactors. We agree with Belgium's regulators that the same testing used to identify cracks in Belgium reactors should be used worldwide, including at Limerick Nuclear Plant.

After learning that 16,000 cracks were found in just two Belgium reactors, 3-16-15, ACE requested material fatigue testing of Limerick Nuclear Plant's two reactors because NRC inspections reports have already identified material fatigue problems at Limerick. Yet, testing was never done and NRC failed to require this testing for Limerick relicensing.

**Independent Reactor Embrittlement Testing Is Essential To Prevent Core Meltdowns And Catastrophic Radioactive Releases.**

Embrittlement causes microcracks, invisible until cracks become large enough to be seen or until radioactive water leaking from the reactor is discovered. Leaking could cause the nuclear reactor's core to be exposed and the core's fission chain reaction would spiral out of control, initiating catastrophic nuclear meltdown.

**Embrittlement of Reactor Metal Is Caused By Radiation Exposure**

- Reactor Pressure Vessel (RPV) metal walls cover the atomic core.
- RPV metal becomes embrittled by being continuously exposed to the radioactive neutron bombardment, resulting from the core's fission chain reaction
- "Fault lines" of microscopic cracks due to metal fatigue are caused by this exposure.
- Undetected "fault lines" can line up creating a crack in the RPV that allows water to leak out of the vessel, exposing the core.
- Undetected embrittlement could even result in the reactor unexpectedly shattering like glass, initiating catastrophic nuclear meltdown.

**NRC's Draft Regulatory Guide Proposal, In Lieu Of Embrittlement Testing To Prove Safety Is Indefensible.**

SUNSI Review Complete

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E-RIDS= ADM-03

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At Limerick, NRC's own documents reveal that the degraded condition of Limerick's reactor structures and associated equipment has been seriously impacted by the constant radioactive stresses of Limerick's 30 years of operations. Those stresses are dramatically compounded by the inherent design flaws in Limerick's GE Mark II Boiling Water Reactors, and Limerick's substandard concrete.

Our review of Exelon's requests for Limerick amendments, reliefs, and exemptions from material fatigue testing suggests that reactor embrittlement could be dangerously pervasive at Limerick.

**Material Fatigue Is Caused By Stresses Put On The Reactors During Routine Operations. Other Stresses, Like Scrams, Compound The Problem.**

**Limerick Has Been Plagued With A Long History Of Scrams That Could Have Caused Substantial Reactor Embrittlement.**

Limerick's history of SCRAM events (planned or unplanned shutdowns) illustrates that aside from neutron bombardment, a great deal of stress has been placed on the entire reactor system and supporting equipment. It is troubling that the root cause of many Limerick scrams has never been identified.

**Examples of Limerick's Many Scrams:**

NRC's 1-31-12 RAI reveals that there were 14 Limerick scrams in 2011. Records show that Exelon has a pervasive history of failing to properly analyze, determine, and correct the root cause of many of the 2011 scram events.

Examples include:

- 2-25-11 - Unit 2
- 4-2-11 - Unit 2
- 5-29-11 - Unit 2
- 5-30-11 - Unit 2
- 6-3-11 - Unit 1

Other Examples of Limerick scrams

- 7-11-12 - Unit 1
- 7-18-12 - Unit 1 - scram and explosion
- 7-27-12 - Unit 2
- 8-31-12 - Unit 1
- 3-5-14 - Unit ?
- 3-11-14 - Unit 1
- 2-24-15 - Unit 1

The 7-11-12 scram revealed reactor fatigue cracks.

- In 1984, it was reported that hundreds of Limerick's safety-related welds were not properly welded by the Bechtel Power Corp. welders and that welds were not properly inspected by Bechtel and NRC inspectors..
- This is especially alarming due to the fact that the 7-11-12 scram was caused by the inoperability of two independent reactor channels, indicating they were subject to vibration.
- **Fatigue cracks were observed** along the weld toe due to reverse bending. Yet NRC granted Exelon "Relief Requests" for weld inspections, irrationally counting relief as compliance for relicensing. In essence, NRC is allowing elimination of a requirement to be a substitute for compliance.

**Embrittlement Issues Are Compounded By Limerick's Inherently Defective Reactors.**

- In April, 1972 a GE Mark II BWR caused a nuclear accident due to the fact that the reactor design could not hold up to the intense vibrations in the reactor created by the cooling process.
- All GE Mark II boiling water reactors, including Limerick's, are inherently defective.
- Unlike Limerick, some nuclear plants scrapped their plants or sued GE due to this reactor defect.
- However, on November 15, 1972 the first component of Limerick's defective GE Mark II BWR arrived on site.
- Supports added to Limerick's reactors to reduce its vibrations would not reduce the vibrating forces inside the reactors.

**New Understandings About Embrittlement Suggest That Specific Embrittlement Testing Is The Only Way To Accurately Determine The Safety Condition Of Limerick's Reactor Structures And Equipment.**

**NRC Did NOT Require Limerick-Specific Embrittlement Testing. Instead, NRC Granted Exelon's Relief Requests For Limerick, Counting Relief As Compliance For Relicensing. This Could Be Happening Elsewhere.**

Testing recommended by some nuclear experts to accurately identify embrittlement and microcracking includes:

- **Ultrasonic Testing** assesses embrittlement damage to the RPV and for concrete ASR damage  
The newest recommendation is that RPVs should have the newer ultrasonic survey which can scan a much larger area of the vessel.
- **Metal Coupons** (in the RPV)  
Coupons are metal samples that are put in the RPV and later removed for examination of degradation to track of the severity of RPV embrittlement. They are more accurate than computer modeling and extrapolations (inferred deductions) that only estimate (and can hide) actual embrittlement.
- **Monitoring "Scrams"** ("startups" & "planned or unplanned shutdowns")  
Transients or scrams cause cyclic strains contributing to reactor fatigue stress
- **Petrographic Analysis** for Concrete Alkali-Silica Reaction (ASR) damage  
Visual inspection does not identify ASR, confirm ASR, or provide the current state of ASR damage (if present) without petrographic analysis.

**WE BELIEVE NRC SHOULD BE USING THE SAME EXACT TESTING THAT WAS USED IN BELGIUM TO IDENTIFY EMBRITTLEMENT MICROCRACKING IN ALL REACTORS, INCLUDING LIMERICK, BEFORE THEY LEAK RADIOACTIVE WATER.**

Independent 3rd party testing experts need to do nuclear reactor embrittlement testing. Exelon should NOT design the testing protocol nor hire the testing company for Limerick, when Exelon has such a huge vested interest in the outcome of this testing.

**We Object To Strategies Used By NRC/Exelon In Lieu Of Testing**

These alternatives allowed by NRC instead of actual embrittlement testing are NOT ACCEPTABLE for Limerick.

- **Extrapolations** - "guesstimates" using data that does not come from equipment in question  
An example of a typical extrapolating: the decision to start up a Unit 1 reactor based on a Unit 2 inspection.
- **Acceptance of unsubstantiated self-serving reports by the licensee**
- **Announced NRC inspections can miss big problems**  
NRC inspectors identifying serious problems, fail to question the industry while conducting inspections within very narrow parameters defined by Exelon.
- **Aging effects prediction models based on a constant 5% rate into relicensing**  
Material fatigue increases with time, yet NRC is failing to acknowledge accelerated percentage rates for material fatigue.
- **Weld overlays to make cracked pipes thicker** - a Band-Aide fix that is becoming routine.

**If Limerick Is Representative Of NRC's Regulatory Process, It Is Clear Our Nation's Nuclear Plants Are Too Risky. NRC Irresponsibly Exempted Exelon From Metal Fatigue Testing At Limerick, Even Though Safety Inspection Reports Revealed:**

- Wear and tear at BWR vessel attachments
- Embrittlement of BWR components due to thermal aging
- Boiling Water Reactor (BWR) stress corrosion cracking
- Loss of material in steel caused by general pitting and crevice corrosion
- Wall-thinning of carbon steel piping components exposed to reactor coolant (water).
- Loss of fracture toughness in some equipment
- Loss of material in submerged bolting (loss of integrity)
- Loss of integrity in gray cast iron and copper
- Loss of material and heat transfer in piping, their components and elements, heat exchangers, and tanks
- Chemical contamination, corrosion, oxidation causing increased connection resistance in fuse holder metal clamps
- Fatigue in fuse holders due to heating, thermal cycling, electrical transients, increased resistance of connection due to fatigue caused by frequent manipulation or vibration
- Failure of Motor Operated Valve (MOV) system that delivers water to the core.
- Cracking or changes in piping exposed to raw water
- Suppression pool in use "beyond its service life"
- Loss of material and cracking in spent fuel pool liner

**It Is Alarming That NRC Has A History Of Weakening And Eliminating Material Fatigue Regulations For Limerick:**

- **Exemptions Granted to Exelon for Limerick Include:**  
EXEMPTED - Fatigue analysis based on Limerick's design code  
EXEMPTED - Fatigue analysis of control rod guide tube
- **Relief Requests Granted to Exelon for Limerick, Including:**  
RELIEF GRANTED - Vessel Attachment Weld Inspection and Evaluation Guidelines counting relief as compliance for re-licensing.
- **Changes Granted to Exelon for Limerick, Including:**
  - 1) Core Operating Limits for Unit 1 GRANTED April 3, 2013
  - 2) Core Operating Limits for Unit 2 GRANTED June 10, 2013
  - 3) Reactor Pressure Boundary change GRANTED
  - 4) License Amendment to Modify Safety Limit Minimum Unit 1 GRANTED, Jan. 30, 2012
- **Exclusions Provided to Exelon for Limerick:**  
EXCLUSION: NRC failed to require embrittlement testing for Limerick relicensing.  
EXCLUSION: NRC refused to address the substandard cement of Limerick's fuel pools as a condition for relicensing.  
EXCLUSION: Computer modeling and mere extrapolations are irresponsibly allowed, even though they have been proven woefully inadequate at predicting the actual severity of embrittlement in Japan.

Instead of requiring compliance with safety regulations and standards, NRC has relinquished safety control to the lobbying group for the nuclear industry (NEI), who in essence determines what regulations nuclear plants will comply with and which ones they will eliminate.

NRC has been rewriting its PTS standards, at least since 1982. When standards are violated, rather than requiring licensees to address embrittlement or shut down reactors, NRC simply weakens PTS standards, irresponsibly allowing severely embrittled nuclear reactors to keep operating, despite the risks for disaster.

It is obvious that embrittlement and cracking risks which we identified for Limerick's reactors require comprehensive independent testing. The issue is long-term nuclear plant stability and the avoidance of catastrophic meltdowns.

**We believe that DG-1299 paves the way to the disaster that Belgium's regulators were trying to prevent when calling for embrittlement testing of nuclear plants world-wide.**

**We Urge NRC To Reconsider Its Current Efforts To Weaken Its Regulations Yet Again, Which Benefits The Nuclear Industry At Public Expense.**

CC: NRDC  
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NRC - Gene Dipaolo  
NRC - Fred Bower  
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